Arizona Industries of the Future Forestry Action Plan

Prepared by

The Arizona Industries of the Future
Forestry Steering Committee

Introduction

The Arizona Department of Commerce Energy Office is grateful for the contributions made by the project coordinator for the original document, Herbert Hopper, and the following Committee members, submitted June 2003:

Herbert Hopper III, Project Manager,
The Little Colorado River Plateau Resources, Conservation and Development Area, Inc.

Dr. Dennis Becker, Research Scientist
U.S. Forest Service

Brian Cottam, Coordinator
The Greater Flagstaff Forests Partnership

Rob Davis, President
Forest Energy Corporation

Mark Engle, Director
Small Business Development Center
Northland Pioneer College

John Hinz, Forester
U.S. Forest Service

Ken Laughlin, Vice President
Arizona Pacific Wood Preserving

Jim Pitts, Tribal Forester
White Mountain Apache Tribe

Lorna Thurman, Director
Life in the Forest

Scott van Der Torn, President
Southwest Forest Products

The original document has since been modified by the industry sector to reflect the needs of a broad spectrum of the Forestry Industry and to become the official Action Plan for the Arizona Industries of the Future Forestry Industry Sector. We wish to express our appreciation to the following individuals for the many hours of personal time and expense devoted to the development of this document, completed June 2004:

Active Committee Members

Committee Chairman:
Ben Hershey, President
Imperial Laminators

Jim Anderson, Forest Planning Staff Officer
U.S. Forestry Service - Apache Sitgreaves Forest

Dennis R. Becker, Research Scientist
USDA Forest Service
Pacific Northwest Research Station

Robert J. Butler, CCP SPHR
Executive Management & Business Consulting

Rob Davis, President
Forest Energy Corp

Mark Engle, Director
Northland College

Steve Gatewood, Program Director
Greater Flagstaff Forests Partnership

Al Hendricks, Forestry Section Manager,
State Land Department

John Hinz, Urban and Community
Forestry Program Manager
USDA Forest Service
Southwest Region
Tonto National Forest

Herbert Hopper III, Director
Little Colorado River Plateau Resource,
Conservation and Development Area, Inc.

Ken Iversen, Vice Chairman
PAWUIC

Debra Larsen, Professor
Northern Arizona University,
College of Engineering & Technology

Lew Levenson, Executive Director
Arizona Partnership for Forest Health

Ken Laughlin, President
Pacific Wood Preserving

Timothy McDonald, Senior Engineer
APS

Bob Moffett, Director
White Mountain Regional Development Corporation

Daniel Musgrove, President
Universal Entech

Chuck Peone, Project Manager
Fort Apache Timber Company

James Porter, Owner
Western Organics

Patrick Reid, Director and Professor
University of Arizona, School of Renewable Natural Resources

Allen Ribelin, Executive
Northern Arizona Loggers Association

Lorna Thurman, Director
Life in the Forest

Scott VanDerToorn, C.O.O.
Southwest Forest Products

Ray Wrobley, President
Southwestern Environmental Consultants

Contributing Members

Kevin Shanley, Account Manager
Empire Southwest

Ed Smith, Northern Arizona Regional Ecologist
The Nature Conservancy, Northern Office

Richard Van Demark, Owner
Southwest Forestry Inc.

Vaughn Wilhelm, Director
Economic Development for Apache County

Elaine Zieroth, Supervisor
U.S. Forestry Service - Apache Sitgreaves Forest

Purpose and Background of the Action Plan

Development of the Action Plan

In 1994, leaders in the forest products industry joined in a unique partnership with the U.S. Department of Energy to foster the development and use of advanced technologies and processes. The Industries of the Future (IOF) was created by the Office of Industrial Technologies to create partnerships between industry, government agencies, and supporting laboratories and institutions to accelerate technology research and development to address specific, high-priority industry requirements. The IOF-Forestry initiative is designed to improve the global competitiveness of the U.S. forest products industry, improve the sustainability of forest management, reduce waste and increase by-product utilization and recycling. Within the context of the IOF program, the forest products industry outlined a vision, goals, and priorities as reflected in the document, *Agenda 2002*. This is a document developed in partnership with forest products industry representatives, the U.S. Department of Energy, and the USDA Forest Service. The U.S. Department of Energy has established state IOF programs across the country to implement the IOF strategy at the state level. The resulting programs are designed to focus and deploy a national strategy in individual states that are customized to meet local needs, resources, priorities, and community interests.

In 2000, the Arizona Department of Commerce embarked on a program to implement the state IOF strategy, in which the forest products industry was identified as a key Industry of the Future. The next step was to create an Action Plan to guide Arizona partners – forest and wood products industry, state government, community-based organizations, and Arizona's post secondary and higher education institutions – to build a competitive and sustainable forest products industry. This Action Plan, which is a result of continuing collaboration among partners, is intended to be results focused and assumes that partners are responsible for and will play a vital role in its implementation. Further, the Action Plan is intended to provide an assessment of the challenges facing Arizona's forest product industry, and advances those specific conditions necessary for the success of the Action Plan. It is recognized that continued collaboration will be necessary as ideas are tried and lessons are learned.

The Role of the Forest Products Industry in Forest Health

Over the last century or more, a variety of factors, including heavy grazing near the turn of the 19th and 20th centuries which removed the grasses that once carried frequent low-intensity fires, and subsequent aggressive fire suppression policies, have combined to interrupt the historic fire cycles over much of Arizona's native forests. This has resulted in forests overstocked with small diameter trees, creating a "ladder fuel" situation, which places millions of acres of Arizona forestland at risk for catastrophic fires. The increasingly destructive cycle of insects, diseases, and wildfire that characterizes the current ponderosa pine and pinyon-juniper forest ecosystems poses a significant risk to personal health, animals, watersheds, and property.

The recent severe wildfires, the Rodeo-Chediski fire in 2002 and the Aspen Fire in and around Summerhaven in 2003, elevated awareness about forest ecosystem conditions and

wildfire risks in Arizona. Forest management response to these, and future, fires is to mitigate fire risks by reducing fuel loads through controlled burns and thinning operations, increasing biodiversity, and restoring forest health. Reducing fuel loads means the removal of small diameter trees in forest stands in addition to other forest management techniques, all of which are costly.

Each of these fuel reduction techniques comes with a cost, however. Given the density of Arizona's forests, controlled burns can be dangerous and may contribute to unhealthy air quality. Harvest costs for small diameter trees frequently exceed log values. Rural communities, most at risk from forest fires, are often economically depressed and are not well positioned to apply resources to reduce wildfire risks. Solutions must be integrated with local conditions and needs. Possible solutions include customizing removal treatments to local market conditions, the use of the latest technology in harvesting and wood products manufacturing, and creating opportunities for rural economies that concurrently reduces environmental and economic losses caused by catastrophic fires. Other environmental benefits to be realized include improved wildlife habitat, reductions in reliance on fossil fuels to generate heat and electricity, increases in available surface water supplies, and improved air quality.

The USDA Forest Service and other federal land management agencies seek to fund forest restoration and forest fire risk mitigation through the National Fire Plan and the recently enacted Healthy Forest Restoration Act. Recognizing the cost of active management and seeking to eventually ease the financial burden on taxpayers to fund these programs, this federal legislation encourages the development of technologies and markets for utilizing small diameter trees and biomass from the forests. Arizona is well positioned to take advantage of such programs. With annual shipments valued at $262 billion, the U.S. forest products industry is a world leader in the production of lumber, wood products, pulp and paper. Arizona's estimated sales of primary forest products were nearly $30 million in 1998 (Keegan et al., 2001). The U.S. industry currently employs approximately 1.3 million people and ranks among the top 10 manufacturing industries in 46 states. While diminished in recent years, Arizona's forest products industry is well positioned to grow, provide quality jobs, and provide a solution to the growing forest health and wildfire problem. Based on current conditions in Arizona this action plan seeks the following:

- Create a results-oriented framework that is current, relevant and marketable for use by the Arizona forest products industry, various state agencies, institutions of post secondary or higher education, and community-based non-profit organizations.
- The Action Plan, when combined with other Industries of the Future action plans, will serve to assist Arizona forest and wood product manufacturers to reduce energy use and costs, while increasing production and competitiveness.
- Emphasize the criticality of developing a forest products industry that incorporates value-added technologies – wood products made by incorporating other materials and/or processing techniques that add value to the wood fiber.
- Create a viable, sustainable industry that is an effective tool in restoring and maintaining healthy forests.

Challenges Facing Arizona's Forest Products Industry

There are a number of obstacles that preclude a robust forest products industry in Arizona. The most critical obstacle is access to the supply of forest material. A recent study by the Greater Flagstaff Forests Partnership suggests that the most significant barrier to private investment in emerging wood products technology is uncertainty about supply. The second obstacle is the lack of legitimate markets for products created from small diameter trees despite the fact that there are legitimate uses for this material. For example, roundwood and finger-jointed materials can be used in construction. Other challenges facing Arizona's forest products industry include:

- The physical characteristics of the forest resource, including strength and tension properties is unknown and inconsistent across the ponderosa pine and pinyon-juniper ecosystems of Arizona.
- There exists a lack of sufficient, pertinent forest products research and development. Many of the businesses pursuing innovative wood products are conducting their own research and development. This is an expensive and time-consuming effort. The research and development efforts that do exist – the Forest Products Lab in Madison, WI, the Wood Center at Colorado State University, and other public facilities – are too far removed from Arizona priorities.
- There is no single group to motivate and represent industry efforts in Arizona. Such a group could promote entrepreneurial investment, marketing, research and development, and serve as a networking medium for industry to exchange information and share resources. Furthermore, an advocacy group could craft the "vision" of the industry in Arizona, by which other partners – federal and state government, related industry, post secondary and higher education, and community-based non-profit groups – could then commit resources.
- The costs of transporting forest material can be prohibitive. As a rule of thumb, it is cost prohibitive to move this material further than 50 miles. Only when significant value is added to the material can the costs of transportation be offset. When the finished product is not of sufficient value, it is necessary to build the processing sites close to the source.
- With the decline of the forest products industry in the past decade, there has been a net decrease in skilled forest practitioners and manufacturers in the State. There are insufficient labor resources to harvest and process the projected volumes of material to be removed from the forest. The next generation of forest laborers will need enhanced skills to thin and conduct forests restoration treatments, for which there are currently insufficient training programs.
- A forest products enterprise in Arizona is expensive to operate. Energy costs versus production output highlights part of the challenge. Retooling the existing forest products industry to use a greater volume of small diameter material and incorporating biomass residuals for myriad of other applications, has promise but not before significant resources are invested into the effort.

- The U.S. forest products industry meets over half of its energy needs with biomass-derived fuel but it is still the fourth-largest user of fossil energy in the U.S. manufacturing sector. The disparity in Arizona is no different.

Partnership Opportunities in Arizona

This Action Plan proposes a commitment by key partners including the Arizona Governor's Office, forest products industry, post secondary and higher education, and community-based non-profit organizations. Other partners within the state identified as vital for the implementation of this Action Plan include:

State of Arizona agencies
Governor Janet Napolitano
Arizona State Land Department
AZ Dept. of Commerce
AZ Dept. of Agriculture
AZ Dept. of Environmental Quality
University of Arizona
Arizona State University
Northern Arizona University
Ecological Restoration Institute

Federal agencies
USDA, Forest Service
U.S. Department of Interior
U.S. Department of Energy
U.S Bureau of Indian Affairs
U.S. Small Business Administration
Office of Senator Jon Kyl
Office of Congressmen Rick Renzi and Jim Kolbe

Industry and private agencies
Arizona Public Service
Salt River Project
Arizona Multibank Community Development Corporation
Arizona Loggers Association
Small Business Development Centers
White Apache Indian Nation
San Carlos Indian Nation
Navajo Indian Nation
Indigenous Community Enterprises

Community-based agencies
Arizona Sustainable Forests Partnership
Greater Flagstaff Forests Partnership
Southwest Sustainable Forests Partnership
White Mountain Wood Products Association
AZ Manufacturing Extension Partnership
Little Colorado River Plateau RC&D
Cocopai RC&D
Coronado RC&D
Arizona Technology Council
Arizona Loggers Association
Blue Ridge Natural Resources Working Group (Pinetop-Lakeside)
Parks-Williams Fuels Management Program
Mount Lemmon Community
Prescott Area Urban-Wildland Interface Commission
Regional Payson Area Project
AZ Partnership for Forest Health (Payson)
N. AZ Technology and Business Incubator

These partners are candidates to play a role in the implementation of the state's Industry of the Future forestry program. For example, The U.S. Department of Energy has an Office of Industrial Technology, which can provide financial support, program oversight and technical assistance to Arizona through its IOF Program team in Washington, D.C. and regional coordinators. The Office of Industrial Technology can provide program

materials, software, industrial assessment databases and other technical assistance. The USDA Forest Service is a key partner. The Forest Service's Forest Products Laboratory regional research stations, including the Rocky Mountain Research Station in Flagstaff, AZ provides leading research on wood recycling, wood processing, and production improvement. Another key partner is Arizona State University and Northern Arizona University. The Industrial Assessment Center at ASU operates an Office of Industrial Technology-funded program that provides small and mid-sized manufacturers with free plant assessments and productivity improvement, pollution prevention and energy efficiency suggestions. The Department of Engineering at NAU provides important research on wood technology. Small Business Development Centers are available to provide clients with valuable business and marketing counsel. The Greater Flagstaff Forests Partnership develops, tests, and demonstrates different approaches to forest restoration and fire risk abatement in the urban-wildland interface. Not unlike other partnerships in the state, it has sponsored ecological and social research projects, has funded research toward the development and marketing of new products from small diameter ponderosa pine, and is fundamental in building community consensus among a diverse range of public stakeholders.

Setting the Conditions for Success

The Action Plan will succeed only when several favorable conditions exist. Success is defined as a viable and sustainable industry that is an effective tool in making progress towards restoring and managing healthy forests. Action Plan partners must pursue establishing conditions for success in Arizona, lest all efforts to create a viable and sustainable forest and wood products industry fail.

Small diameter trees will be the largest source of material for the wood products industry for the foreseeable future. It should be understood (and assumed) that the future of forestry in Arizona shares little in common with the deep history of logging in the U.S. over the past century. It is inconceivable that a vast timber industry based on the wide scale harvest of large trees will ever return to Arizona. That activity will likely be replaced with a different enterprise, one that provides a service to land managers while concurrently sustaining a new type of forest products industry. Logging and timber production will likely be replaced by thinning and biomass removal. The mechanical applications of forest treatments will provide the forest products manufacturer a significantly different mix of materials from which to make products. Small diameter material will be in far greater supply than the larger, traditionally more marketable trees (commonly referred to as yellow pine for ponderosa pine). It cannot be over-emphasized that the industry must make the shift to utilizing small diameter trees if it is to be a part of the healthy forest equation while having a sustainable existence.

New technology, new products, and expanded markets must characterize the forest products industry. Taking otherwise low-value material and transforming it into financially viable products requires a significant shift in thinking. A new strategy must be crafted that demands lower manufacturing costs, an abundant and skilled workforce,

superior energy performance, and increased value-added products. Regardless of the product, production must encompass new technology to be both viable and sustainable. Existing business operations have shown that it is feasible to make value-added products from small diameter material by utilizing new technologies, such as glulam beams or wood waste combined with recycled products. The small diameter ponderosa pine is currently considered a lower grade and lower value material because of its smaller diameter and higher rate of defect such as knots and juvenile wood. However, its lower material cost makes it attractive to niche manufacturers when compared to other materials used in specialty markets, remodeling, "green" building, and light construction.

Forest material must be available and the industry must have assurances that the material will be available at a continuous rate. A condition for success is that our forested lands be made available for the removal of the small diameter material and the excess woody biomass that dominates our forests. As consensus is reached among political interests, scientists, conservation organizations, and concerned citizens and stakeholders, forest resources need to be made available for a forest products industry to sustain. Wood supply for businesses is almost entirely dependent on forest management and restoration activities on National Forests. Investors need assurance that restoration efforts and the harvesting of small trees will be orderly, ongoing, and resulting in a consistent, stable supply of material.

Forest health is directly tied to community health. While restoring forest health and reducing the risk of severe wildfire to communities are responsibilities to be shared by federal, state, tribal, local and private landowners, a viable and sustainable forest products industry, as a key component of that commitment, demands a strong working partnership with the communities that provide the resources to sustain their business. Regardless of where a forest product is assembled, forest-connected communities must possess the infrastructure to support and sustain both the removal of forest material, and eventually, the forest products industry. Forest-connected communities need significant externally based resources to meet the demands that industry will ask of them to develop or improve such infrastructure as roads, utilities access, and commercial parks.

Action Plan for the Future of Arizona Forestry

The following tasks and actions comprise the Action Plan. It should to be accomplished within three years. The Action Plan also implies that a Memorandum of Agreement be signed with the key partners – Arizona Governor's Office, industry, post secondary and higher education, and community-based non-profit organizations – committing their resources toward achievement of these goals.

Create an advocacy group that promotes the Arizona forest and forest products industry while concurrently communicating to the public on issues such as forest ecosystem health and the merits of purchasing

Arizona wood products. To be accomplished by the forest and wood products industry.

Expand efforts to assist existing industry in developing or incorporating new processes or technology for mechanical forest treatment, product development and market opportunities. Establish the priorities for a government-industry collaboration that develops and tests improved manufacturing processes and equipment to produce value-added products from forest restoration and fuel reduction treatments including small diameter material, woody biomass and other by-products. Promote increased public awareness of wildfire, hazardous fuels reduction, and communicate the role of industry in mitigating these problems. Create and support new market opportunities for such things as liquid fuels and other forms of biomass energy. Actions associated with this task include:

1. Create an annual forum that brings together all the practitioners, processors and manufacturers, in order to better integrate and complement their efforts.
2. Create and implement a public relations program (e.g., Buy Arizona First, Healthy Forests mean Healthy Communities, Healthy Forests Provide Water for Arizona) that stresses air, water, waste energy, watersheds and other natural resources.
3. In close cooperation with state and local governments, target infrastructure for expanded development. The advocacy group will promote techniques such as clusters that incorporate a "forest-to-consumer" approach for use in developing infrastructure.
4. Interact with other industry groups to highlight the advantages of using forest products in their businesses. Serve as the catalyst to deliver new technologies and markets to industry stakeholders.
5. Conduct market research and identify the forest product needs of consumers.
6. Be a leader in communicating with government, post secondary and higher education, and community-based non-profit partners in setting priorities for Arizona forest and wood product research and development.
7. Create and distribute a newsletter that regularly updates business stakeholders on forest and wood products industry activities and developments.
8. Provide manufacturing workshops and industrial assessments to emphasize energy efficiency, boost competitiveness, lower production costs, enhance environmental performance, and reduce waste.

Create government and financial incentives for private businesses to expand current sustainable forest and wood products manufacturing, and develop emerging technologies in the forest products industry. To be accomplished by state government.

Actions associated with this task include:

1. Support creative use of tax credits, subsidies, and grants for equipment purchases and innovative suitable manufacturing technologies.
2. Promote, through tax incentives and enterprise zones, expansion of funded mandates, the harvesting, processing, and consumer use of biomass for combined heating and electric generation with particular focus on rural communities neighboring forested lands. Similarly, promote sustainable development of alternative energy and heating from biomass as part of the Arizona Environmental Portfolio Standard (EPS).
3. Seek similar incentives for alternative biomass technologies including wood-plastic composites, bi-oils, and other bioproducts.
4. Promote, through tax incentives and enterprise zones, existing and emerging sustainable economic uses for small diameter trees as a method to promote economic development and to retain and create local jobs and to increase forest restoration treatments.
5. Create a timely grant and incentive program to assist forest practitioners, wood processors and manufactures to develop innovative uses for forest materials. Create grant programs or incentives for urban areas for conversion of waste to biomass or other product uses. The grant may also extend to educational and outreach efforts.
6. Publish annually an inventory of available solid wood and biomass raw material for use by the industry that encourages the purchase of Arizona materials.
7. Promote, through competitive purchase agreements and other incentives, the use of wood products made from small diameter trees and woody biomass in the construction and procurement of the State of Arizona facilities and contracts.
8. Create community development grants and incentive programs to assist property owners to reduce forest fuel for wild fire protection.

Under the leadership of community-based non-profit organizations and in collaboration with community development representatives and financial institutions, assists forest practitioners, wood processors, and manufacturers to purchase equipment, expand production, and perform manufacturing assessments designed to build long-term sustainability.

Actions associated with this task include:

1. Create a funding program that makes available low interest bonds and loans.
2. Provide business development counseling and technical assistance to forest products practitioners and manufacturers.
3. Assist the forest and wood products industry to retool and upgrade equipment to facilitate the utilization and manufacturing of small diameter trees and biomass.
4. Promote local markets and opportunities to revitalize forest and wood products businesses.
5. Establishing opportunities to enhance economic development with forest-connected communities.

Create research, development, demonstration, education, and training programs to develop, test, and market improved manufacturing processes and equipment to produce cost effective, value-added goods from forest thinning and restoration materials. To be accomplished by Arizona post secondary and higher education institutions.

Toward this end, assist Arizona forest product manufacturers to reduce energy use and costs and increase productivity and competitiveness. Assist industry in becoming an economically viable partner in forest restoration efforts by improving restoration work site efficiency, improving manufacturing energy efficiency, increasing renewable energy use and markets, developing new products, improving design and utilization in housing, and researching material properties and accessing researching niche market opportunities. Actions associated with this task include:

1. Create a workforce-training program to address the critical need for certified forest practitioners and forest product production skilled labor. This could be expanded to include a corps of forest and forest product professionals.
2. Establish regionally based research, development, and demonstration programs to develop emerging technologies and uses of wood products and disseminate this information to the industry.
3. Promote the use of plant-wide assessments and best manufacturing practices.
4. Work with industry to re-create educational programs to promote the forest industry sector in cooperation with State educational institutions.

Recommended research, development, and demonstration priorities for the forest products industry

- The use and application of woody biomass as an alternative energy source.
- The merits of biofuels and biochemicals from woody biomass.
- Environmentally friendly substitutes for the processes currently used in the wood preservative industry.
- Reduce the time and expense of drying cut lumber.
- Reduce the labor and expense of removing woody biomass from our forests.
- Reduce the expense of transportation and the logistic handling of forest and forest products, from “forest-to-consumer.”
- Explore opportunities to enhance economic development in forest-connected communities related to the utilization of small diameter material.
- Explore the merits of creating a network of clusters and incubators to promote the development and expansion of a forest products industry.
- Explore the merits of replicating examples of widespread incorporation of woody biomass-based energy is highly successful.

- Explore the expanded use of soil erosion controls, reseeding, and dust abatement technologies using woody biomass for uses in land reclamation applications, road construction, and maintenance.

Opportunities for Arizona Forest and Wood Products

There is a wide range of marketable products that can be manufactured from Arizona's forests. They range from traditional building materials, furniture, and firewood to emerging products demanded by an international consumer. Arizona is well positioned to provide its citizens with wood products of all types. Currently, much of the wood products purchased from Arizona businesses are manufactured with wood from outside the State. This is a discrepancy that can be seized upon. Arizona has an opportunity to utilize wood from its own forests to meet local demand while improving ecological conditions of Arizona forests.

In contrast to products created from large trees, wood products from small diameter trees possess a number of challenges. Small diameter ponderosa pine has numerous limbs and, as a result, the wood has a high frequency of knots, some often large. The wood is dense, tree rings crowded close, which results in warping and un-uniform wood after drying. The wood may also crack, split or check during drying and can result in considerable loss and waste, and is also characterized by low strength properties due to high ratios of juvenile wood. Yet, ponderosa pine is suitable for a number of value-added products. Testing and evaluation of is a prerequisite for successful product lines. In addition to wood as a key component in such products as furniture, molding and cargo pallets, there are other, less familiar forest and wood products applicable to Arizona:

Posts and poles. Used most often in fence construction, posts and poles must be treated with chemicals to resist decay. Posts and poles generally require a uniform log with minimum taper. Other uses for roundwood include stair and deck banisters and balustrades, latillas, decorative posts and rustic furniture. Some manufacturers have successfully developed utility-type sheds using long poles. Others have used peeled poles and posts for framing barns, sheds, kiosks, ramadas and other outdoor shelters. For example, small diameter logs are used successfully to construct Navajo Hogans in Cameron, AZ on the Navajo Indian Nation. Research and marketing assistance improves opportunities for this lower-value segment of the industry.

House logs. Natural house logs are 10-inch or larger logs, cut to length, peeled and notched, and uniform in size with little taper. Small diameter logs may have defects that render it unsuitable for house logs. Machining or milling small diameter logs can produce attractive, uniform-sized material, with a corresponding significant increase in value for the manufacturer. Additionally, using half logs or log slices has been used effectively for siding to resemble a log home.

Biomass refuse. The tops, limbs and other low-value refuse, commonly referred to as slash when removed as forest thinnings, has historically been the source material for

landscape mulch, compost, and soil amendments. Chipped, shredded or ground mechanically into the desired particle size, these products are extremely sensitive to the cost of harvesting, transporting, and processing the material. Therefore, this product line is not likely to be a stand-alone enterprise, but one element of a wood products cluster where every component of a tree is used. An desirable option is the use of slash as a fuel in a boiler that can then provide heat and electricity (cogeneration) to the cluster.

Shavings and animal bedding. Arizona's horse and livestock industry has indicated a need for shavings and animal bedding. Similar to processing slash, bagged dry shavings and sawdust are profitable when costs for handling and transporting can be minimized.

Oriented strand board (OSB). OSB is an ideal use of large volumes of small diameter ponderosa pine, imparting significant value onto otherwise low-value material. In this process, peeled logs are cut to the desired length and further sliced into thin wafers. The wafers are coated with a resin and oriented directionally into a thick mat. Heat and pressure are applied to compress the mat into a board with a set thickness, which are then trimmed to desired dimensions. Larger, well-established forest products corporations have the financial and technical resources available to commit to a project of this magnitude.

Biomass heating. The use of biomass for heating purposes has long been a utilization option for small diameter trees. Biomass either in the form of densified wood pellets or wood chips can be used in stoves or small heating plants and is capable of using large volumes of material. Pellet heating has long-term economic promise. Each ton of pellet fuel is approximately 16.5 million Btu, which would meet half of an average home's annual heating requirement and compares favorably with fossil fuel heat sources.

Emerging technologies. Exciting opportunities exist for incorporating other materials with ponderosa pine or its residue. Products made with cement and wood hold potential for a number of uses. The mixing of wood fiber with plastic for extrusion into composite products is a viable possibility for utilizing recycled plastic and wood residues. When impregnated by special starches and glues, ponderosa pine could have application in structural beams and flooring. Certainly not all the potential uses for small diameter trees have yet been discovered. Wood is a versatile material whose value will appreciate significantly if combined or complimented with another material or substance.

Valuable References

There is a wide assortment of published material that is relevant to the creation of an Action Plan. Contributors to the Action Plan found value in the following resources. They are assembled here as a convenience to gain insight to the underlying themes of the Action Plan. Excerpts are included to provide a flavor for the resources. Furthermore, these resources offer data and information on new and emerging opportunities of forest harvesting, wood products manufacture, energy efficiency, and energy technology.

Governor Janet Napolitano's First Annual Forest Health and Safety Conference, Building on Lessons Learned, Action Plan for Arizona, April 10, 2003. This document captures the results of the First Annual Conference on Forest Health and Safety. The conference brought together a diverse group of dedicated individuals who share a common goal of protecting Arizona's forests. You will find in this Action Plan for Arizona a list of many goals and recommendations aimed at preserving Arizona's forests. One stated goal is to evaluate existing and potential sustainable economic uses for small diameter trees for their compatibility with long-term protection of forest health and economic development opportunities focused on creation of local jobs. Included were recommendations to expand marketing efforts of Arizona wood products and coordinate through the Arizona Department of Commerce.

Recommendations for Reducing Unwanted Wildfire Risk and Restoring Forest Ecosystems in Arizona, a report prepared by The Governor's Forest Health/Fire Plan Advisory Committee for Governor Jane Hull, July 29, 2002. The purpose of this document is to make recommendations to the Governor of Arizona for the implementation of hazardous fuel reduction and forest restoration treatments for Arizona. The recommendations are the product of discussions by the Arizona Governor's Forest Health and Fire Plan Advisory Committee. One stated recommendation was to build and support the federal, state, local and tribal capacity required for success. Implementation efforts have revealed that the capacity to accomplish fire risk reduction lags behind the urgency of the situation. In this case capacity refers to individuals, funding for key programs and infrastructure. It report goes on to recommend that economic incentives be provided for the development of appropriate utilization technologies and restoration-based businesses such as tax credits, low interest loans, or loan guarantees.

Greater Flagstaff Forests Partnership (GFFP) Small Diameter Wood Utilization Study, A Wrap-Up and Implementation Report, Restoration Resources and Investment Potential, July 2002, prepared by Mater Engineering, Ltd, P.O. Box 0, Corvallis, OR 97339, 541/753-7335. The GFFP can be reached at 1300 S. Milton, Suite 218, Flagstaff, AZ 86001, 928/226-0644. This report follows a year and a half-long study identifying and assessing options for the productive use of the small diameter ponderosa pines. The study clearly shows that technology to make useful products exists elsewhere, and the markets for the resulting products exist as well. The study highlighted a number of emerging technologies and inferred they are applicable for Arizona. Such technologies include Sorbilite, which is a system that can produce products from ground or shredded material by mixing the material with granules of recycled thermosetting plastic and compressing the mixture into a mold and subjecting it to high pressure. Indurite is a starch-based wood modification treatment that can significantly increase the hardness, density, fire resistance, mechanical strength characteristics, exterior use durability, and can color red or stain the wood to a desired finish.

Greater Flagstaff Forests Partnership (GFFP) Small Log Sawmill Site Assessment Study for Northern Arizona, October 2002, prepared by Mater Engineering, Ltd., P.O. Box 0, Corvallis, OR 97333, 541/753-7335. The GFFP can be reached at 1300 S. Milton, Suite 218, Flagstaff, AZ 86001, 928/226-0644.

Four Corners Sustainable Forests Partnership 2001-2002 Demonstration Grants Program Evaluation Report, October 2002, prepared by Sam Burns and Tim Richard, Office of Community Services, Fort Lewis College, Durango, CO 81301-3999, 970/247-7333. The Arizona Coordinator for the Four Corners Sustainable Forests Partnership can be reached at the Little Colorado River Plateau RC&D, 51 W. Vista #4, Holbrook, AZ 86025, 928/524-6063, ext. 5., www.littlecolorado.org. The authors document how the Four Corners Sustainable Forests Partnership (FCSFP) is witnessing a modest increase in capacity to harvest and process low-value or traditionally non-merchantable material. Grant recipients of the FCSFP are part of a Four Corners-wide, multi-level effort to build a new economic and physical infrastructure that is positioned to utilize small-diameter pine and other wood products of restoration and thinning work. Infrastructure development is taking place, both physically and economically in planning for eventual access to forests to do restoration harvests. The authors highlight the need to create a long-term sustainable strategy based on multi-products and multi-markets. Several businesses and community organizations are working together in concert to address a problem that is larger than any single agency, organization, or business can solve alone.

The Southwestern Region's Forest-Based Community Economic Development Grant Program: Economic Effects in the Apache-Sitgreaves and Lincoln Working Circles, 2001-2002, a report for the State of New Mexico Energy, Minerals and Natural Resources Department by Gregory S. Alward, Michael J. Niccolucci and Susan A. Winter; USDA Forest Service, Inventory and Monitoring Institute, Suite 300, Building A, 2150 Centre Ave, Fort Collins, CO 80526, www.fs.fed.us/institute. This report was prompted by the Southwestern (AZ and NM) Region's desire to assess the impact of forest-based community economic development grant programs, which were undertaken to encourage the development of sustainable economic endeavors like private business, public-private partnerships, and trade associations to process small-diameter wood throughout New Mexico and Arizona. Regarding the economic consequences of spending $4,443,368 grant funds on demonstration projects in the Apache-Sitgreaves working circle (AZ and NM), the study concluded that "120 local jobs and $1,148,200" was generated. Further, the study suggests that for the same area "6 to 84 jobs per million dollars of sales, and $215,000 to $548,000 of local labor income per million dollar sales" could occur if these demonstration projects are successful in creating sustainable businesses.

Use of Public Lands to Fuel Biomass Electric Power Production, by William H. Carlson, Vice President and Alternative Energy Group General Manager, Whellabrator Environmental Systems, Inc, a presentation before the National Conference on Opportunities to Expand Renewable Energy on Public Lands, November 28, 2001. The author examines the challenge and the economics of reducing fuel loads in our nation's forests. He concludes, "Clearly, mechanical thinning of overstocked national forests lands in the West over the next two decades can solve a major share of the forest health and fire potential problems. Though the quantities of material that must be removed are staggering, they could be accommodated in forest products mills and biomass power plants without unrealistic changes to the region's infrastructure." He cites several

benefits including, "restores fairly large-scale economic activity in areas of the West that have suffered great economic distress due to reductions in activity on federal lands. Avoids the massive air pollution and threat of escape that has plagued a large scale prescribed burning program. Dramatically increases the amount of renewable energy produced in the West, taking pressure off our imported fossil fuel needs, moving us one step closer to energy independence. Allows private capital to replace federal dollars in solving our forest and range health problems. Can be a solution that brings together diverse interests in support."

Methods Used to Harvest Small Diameter Trees in Colorado, a presentation by Kurt H. Mackes, Assistant Professor, Department of Forest Sciences, 131 Forestry Building, Colorado State University, Fort Collins, CO 80523-1470, 970/491-4066, kmackes@cnr.colostate.edu. This presentation summarizes research in southern Colorado on the economics of removing small diameter trees. The author cites several barriers to utilizing small diameter material including, "real and perceived quality issues of ponderosa pine; opposition of certain environmental groups to fire mitigation work and forest restoration thinning; the economics of harvesting small diameter trees; the lack of sufficient stable wood supply; and the unwillingness of the industry to invest capital given the past history of wood supply. Future forest restoration and fuel mitigation programs must be designed to provide a consistent supply of raw material to wood processors. There is no single product that will utilize all small diameter trees in the Intermountain West."

Small Diameter Utilization, a presentation by Dan Len, USFS Program Manager, Forest Management, 2150 Center Ave, Building A, Suite 343, Fort Collins, CO 80526-1891, 970/295-5751, dlen@fs.fed.us. This presentation covers the details of "forest-to-consumer" for small diameter trees. For example, the list of small diameter products includes, sawlogs, structural lumber, non-structural lumber, poles/posts, oriented strand board (OSB), laminated dimension (glulam), finger joint dimension, flooring, paneling, lattias and vigas, cabinets, furniture, pallets, bio-energy (ethanol, electricity, thermal heat, gasification, cogeneration), firewood, composites (plastics or cement), composites with laminate, wood fiber filters, wood fiber mats (erosion control), compost and mulch, and pulp chips (for paper).

Opportunities for Making Wood Products from Small Diameter Trees in Colorado, by Dennis L. Lynch and Kurt H. Mackes, a research paper (RMRS-RP-37) prepared for the USDA Forest Service, Rocky Mountain Research Station, September 2002. The concluding statement in this eleven-page document is, "if a thinning program is initiated and agencies encourage businesses and communities to participate, innovative and creative people will find many ways to use wood to meet society's needs."

The New Pioneers: Hope Rises From the Ashes in Southwestern Forests, Jim Petersen, editor, summer 2002 edition of Evergreen Magazine, P.O. Box 1290, Bigfork, MT 59911, www.evergreenmagazine.com

Wildfire Risk Management and Emergency Preparedness: Flagstaff, Arizona, a report prepared for the National Academy of Public Administration Forest Fire Panel, October 1, 2002, by Kathleen Hemenway, PhD, 8452 Hansa Trail, Snowflake, Arizona 85937, 928/536-6075, hemenway@asilo.com. The author offers the following, "what is needed is active management of the supply-side by the Forest Service. Coordination is needed across local national forests in order to manage volume and mix (i.e. proportion of logs in each diameter range); timing of delivery; and geographic location of delivery. As the NEPA process takes two years, planning and scheduling need to be put in place to keep the projects flowing steadily through the NEPA pipeline. According to the Mater Engineering report, this coordination should at least include the three larger national forests in Northern Arizona – the Coconino, Kaibab and the Apache-Sitgreaves National Forests. Whereas now it seems as if 'the process is the product,' we need to evolve to a process that enables us to get broad-scale work done on the ground, quickly. This will entail a paradigm shift. The new paradigm will be one that doesn't put the science of restoration on trial with every project. It will be one that is sensitive to local conditions but that enables Forest Service employees and other restoration workers to get a lot of work done in a safe, effective and efficient manner."

Wildfire Risk Mitigation and Emergency Preparedness: Prescott, Arizona, a report prepared for the national Academy of Public Administration Forest Fire Panel, September 30, 2002, by Kathleen Hemenway, PhD, 8452 Hansa Trail, Snowflake, Arizona 85937 928/536-6075, hemenway@asilo.com.

Wildfire Suppression: Strategies for Containing Costs, a study by a panel of the National Academy of Public Administration for the U.S. Congress and the Departments of Agriculture and the Interior, September 2002. The purpose of this study is to develop the foundation for a new federal program that could be designed to stimulate greater intergovernmental cooperation to reduce wildfire hazards on a large scale across wildlands and in communities. "The Panel is convinced that the greatest opportunity for containing suppression costs lie in building the capacity to control two of the main factors that are increasing these costs – the accumulation of hazardous fuels and the increasing exposure of human development to these hazards." The Panel recommends that the Wildland Fire Leadership Council lead revitalized efforts by the federal land management agencies to partner with communities and industry to promote biomass utilization programs that could create sustainable supplies of useable materials, jobs, and revenues at the local level to offset fuel reduction costs.

Arizona's Forest Products Industry: A Descriptive Analysis 1998, Compiled by Charles E. Keegan III and associates, Forest Industry Research at the Bureau of Business and Economic Research, The University of Montana, Missoula, Montana.

A Research Reference Guide, Second Edition, March 2003, Compiled by Jackie Marlette for the Greater Flagstaff Forests Partnership, 1300 S. Milton Road, Suite 218, Flagstaff, Arizona 86001, 928/226-0644, www.gffp.org. This second edition focuses primarily on GFFP projects or on ponderosa pine restoration research being conducted within the Flagstaff wildland-urban interface.

Review of Log Sort Yards, General Technical Report FPL-GTR-132, by John Rusty Dramm, Gerry L. Jackson and Jenny Wong, October 2002, Forest Products Laboratory, One Gifford Pinochet Drive, Madison, MI 53726-2398. The log yard projects seek to identify and overcome barriers and document successes in an effort to help meet the needs described in the report. While the USDA Forest Service is oriented toward small log sort yards to help timber-dependent communities recover from changes in timber supply, this information applys to large commercial log sort yard operations as well.

A Strategic Assessment of Fire Hazard in New Mexico, a report prepared for the Joint Fire Sciences program, in cooperation with the USFS Pacific Northwest Research Station, by Carl E. Fiedler, Charles E. Keegan III, Stephen H. Robertson, Todd A. Morgan, Chris A. Woodall and John T. Chmelik, February 11, 2002.

The Value of the Benefits of U.S. Biomass Power by G. Morris of the Green Power Institute in Berkeley, CA, a report prepared for the National Renewable Energy Laboratory, 1617 Cole Blvd, Golden, CO, November 1999.

Forest products – Industry of the Future, a pamphlet by the Office of Industrial Technologies, U.S. Department of Energy.

Rural Economic Development Through Integrated Smallwood Forest Products Centers, a paper by James H. Dooley, PhD, P.E., written for presentation at the 2002 American Society of Agricultural Engineers annual international meeting, Chicago, IL, July 28, 2002.

Opportunities and Challenges of Utilizing Small Diameter Timber from Fuel Reduction Thinning Programs, a paper by Eini C. Lowell and R. James Barbour, written for presentation at the 2002 American Society of Agricultural Engineers annual international meeting, Chicago, IL, July 28, 2002.

The Forest Products Conservation & Recycling Review, a periodic newsletter assembled and edited by Adele Olstad and John Zerbe of the FPC&R Technology Marketing Unit at the Forest Products Laboratory, One Gifford Pinochet Dr., Madison WI 53726-2398, 608/231-9200, aolstad@fs.fed.us or jzerbe@fs.fed.us.